The TanDEM-X Digital Elevation Model and Terrestrial Impact Craters

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TanDEM-X Mission

TanDEM-X (TerraSAR-X add-on for Digital Elevation Measurements) is a German radar mission (Ref. 1). Two identical X-band satellites – launched in 2007 and 2010 – fly in close helix formation to act together as a single-pass interferometer. Both spacecraft are separated by a baseline of only 200-500 m (Fig. 1).

Fig. 1: Artist's impression of TanDEM-X operating as a single-pass interferometer.

Accuracy	
Relative vertical	2 m (slope < 20%) 4 m (slope > 20%)
Absolute vertical	10 m
Relative horizontal	3 m
Absolute horizontal	10 m
Spatial resolution	12 m × 12 m
Coverage	global

Table 1: TanDEM-X DEM requirements.

From the measurements acquired between end 2010 and early 2014 a global DEM with unprecedented accuracy and coverage is produced (Table 1). This DEM shall be available by mid 2015.

DEMs and Impact Crater Mapping

DEMs are well suited for studying the topography of impact structures. The best space-borne DEM available so far had been generated by the Shuttle Radar Topography Mission (SRTM) in February 2000 with spatial resolutions of 90 m (C-band) and 30 m (X-band). Full coverage between 56° S – 60° N existed for the C-band but was only partial (40%) for the X-band. How the TanDEM-X DEM improves elevation information is demonstrated in Fig. 2.

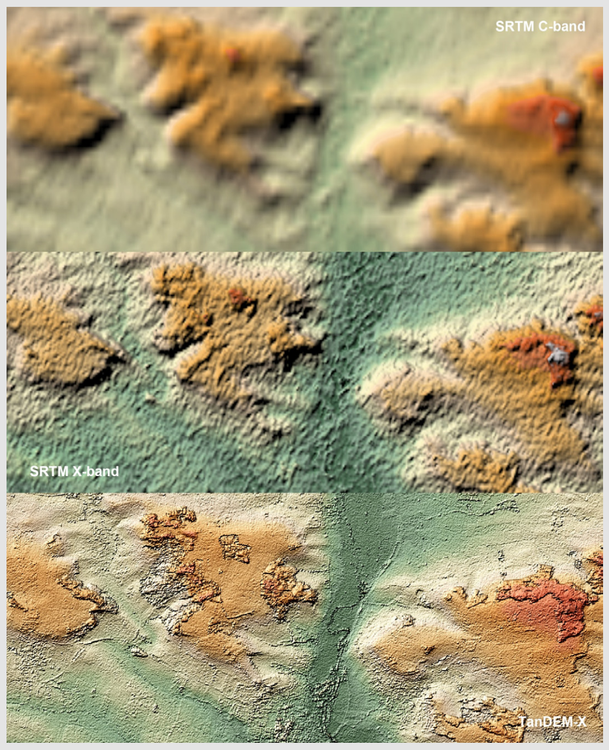
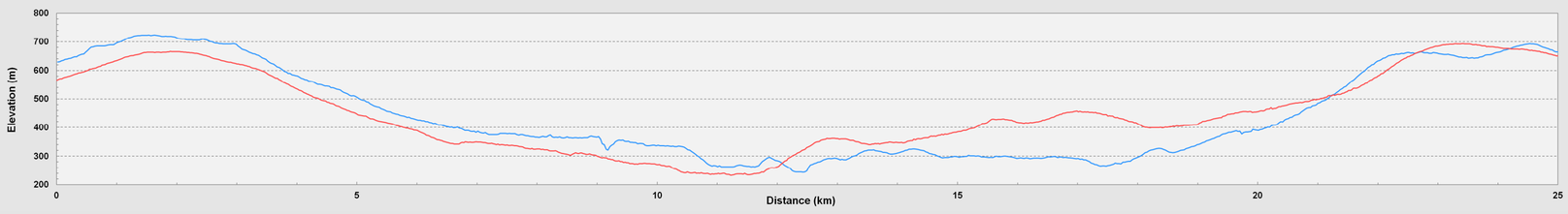


Fig. 2: Comparison of SRTM and TanDEM-X DEM images of a northern segment of the Ries crater.

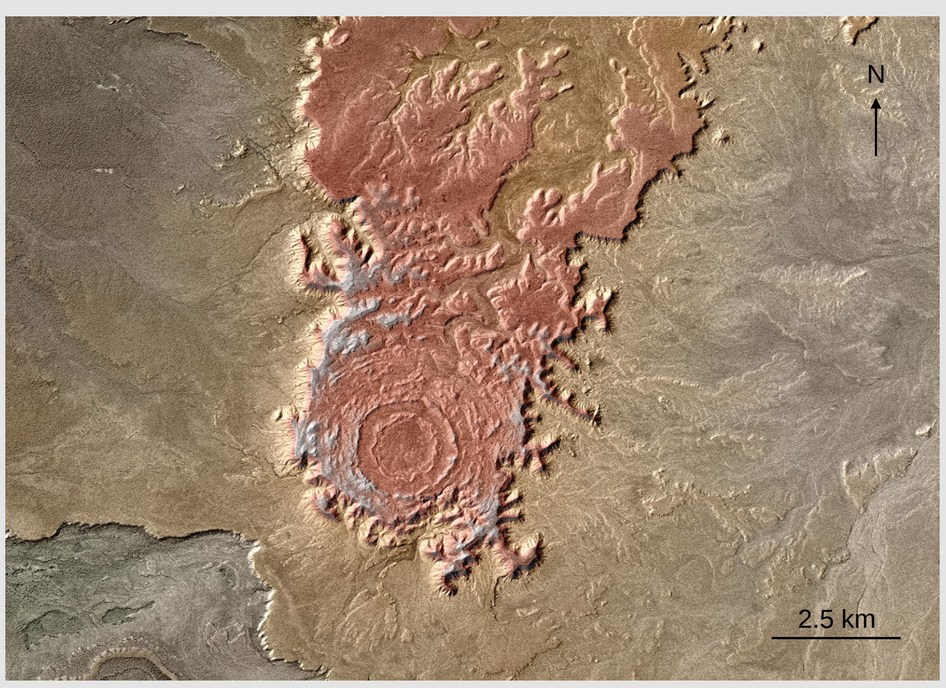
Fig. 3 (right): The Tin Bider structure in Algeria (top) and Logancha in Russia (bottom). In the Logancha display both transects for the elevation profiles of Fig. 4 are illustrated.

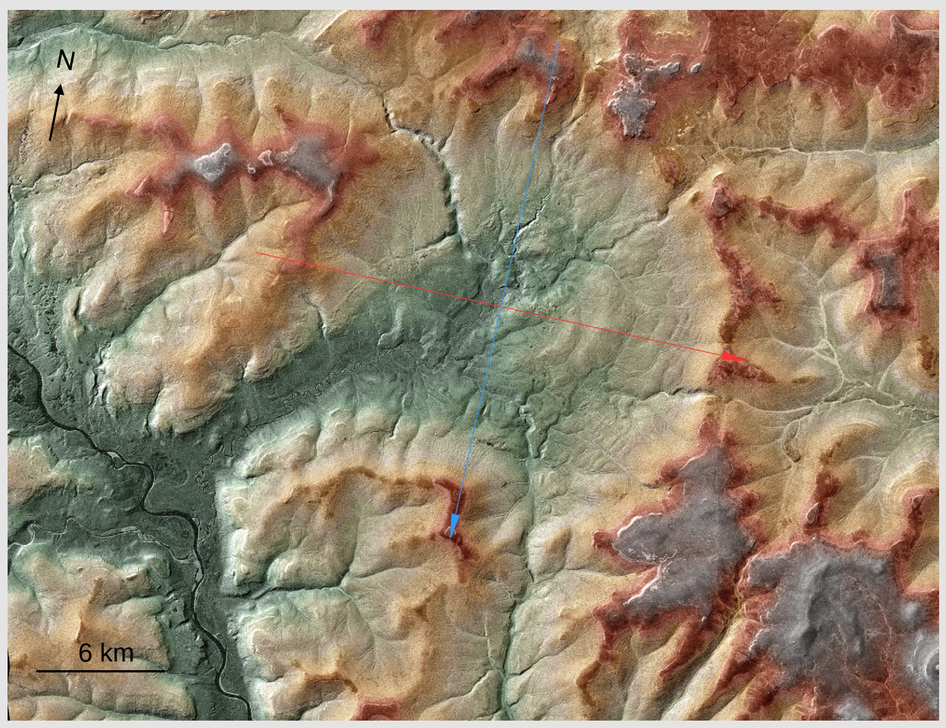
Fig. 4 (bottom): A west-east (red) and north-south (blue) elevation profile through the Logancha structure.



TanDEM-X DEM and Impact Craters

We analyzed TanDEM-X DEM information for mapping the 184 confirmed structures in the Earth Impact Database (EID) of the Planetary and Space Science Center (PASSC) at the University of New Brunswick, Canada. The DEM illustrates impact related topography at about 100 EID sites. First results have been given in Ref. 2. Here we present further high-quality TanDEM-X maps and elevation profiles of terrestrial impact structures (Figs. 3 to 5). They comprise both simple and complex structures of various sizes and preservation status.





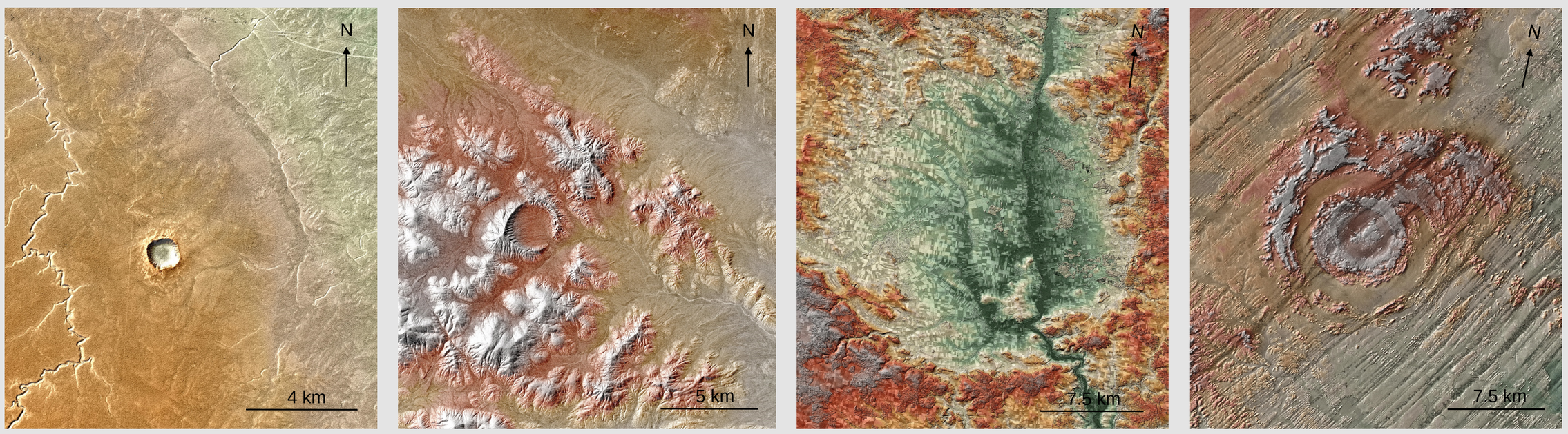


Fig. 5: Simple and complex impact structures illustrated with the TanDEM-X DEM (from left to right): Barringer in Arizona, Shunak in Kazakhstan, Ries in Germany and Aorounga in Chad. Each map is a combination of the hillshaded DEM and the X-band amplitude signal.

Ref. 1: Krieger et al., TanDEM-X: A radar interferometer with two formation-flying satellites, Acta Astronautica 89, 2013.
Ref. 2: Gottwald et al., Mapping terrestrial impact craters with the TanDEM-X DEM, Large Meteorite Impacts and Planetary Evolution V, Sudbury/Canada, 2013.

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DLR Deutsches Zentrum für Luft- und Raumfahrt